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SHORT COMMUNICATION

Activity pattern and predatory behaviour of the ocelot (*Leopardus pardalis*) (Carnivora, Felidae) in mineral licks of the Yasuni National Park, Ecuador

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Abstract

The ocelot, *Leopardus pardalis*, is one of the opportunistic predators of the tropical forests that includes birds, small and medium mammals, amphibians and reptiles in its diet. Aiming to observe its behaviour within its natural habitat, 10 cameras were installed in 10 mineral licks within the Yasuni National Park (Ecuador). Both images and videos of ocelot predation events were collected. Hence, the frequency of activity of this specie was determined with the register of captures obtained. Three events are described: the first one, an image of an ocelot stalking a *Mazama* deer was taken, while in the second scene, a video of stalking an anuran was obtained and in the third event, a video of the ocelot capturing a flying bat was recorded. The use of camera traps allowed us to collect valuable behavioural information about this feline and provide evidence of the importance of the mineral licks for this and other wild species.

Resumen

El ocelote, *Leopardus pardalis*, es considerado uno de los depredadores oportunistas de los bosques tropicales. Este incluye en su dieta aves, mamíferos pequeños y medianos, anfibios y reptiles. Mediante 10 cámaras trampa instaladas en 10 saladeros dentro del Parque Nacional Yasuní, se filmó y se fotografió eventos de acecho y depredación del ocelote a otras especies de fauna que emplean estos sitios. Con los datos obtenidos se determinó la frecuencia de actividad de esta especie, y se describió tres eventos: el primero en una fotografía acechando a un venado del género *Mazama*, otro en un video donde se ve el

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acecho a un anuro y el último en un video donde el ocelote captura a un murciélago en vuelo. Este método permitió obtener información valiosa sin interferir en el comportamiento habitual de este felino, además evidencia la importancia de los saladeros para esta y otras especies de fauna silvestre.

Keywords
Activity patterns, camera trap, mineral lick, ocelot, predator, Yasuni

Palabras clave
Patrones de actividad, cámara trampa, saladero, ocelote, depredador, Yasuní

Introduction

The ocelot (*Leopardus pardalis* Linnaeus, 1758) is a solitary and elusive medium-sized mammal of the Felidae family. Due to its elusive behaviour, very little information about is natural habits is available. The distribution range of this felid ranges from southern North America to the north of Argentina and Uruguay. Moreover, it occupies several ecosystems, such as humid tropical forests, tropical dry forests and floodable and desert areas from 0 to 3000 m a.s.l. The ocelot can reach up to 80 cm in head-and-body length and can weigh up to 10 kg. It has a robust and rounded head, convex snout, large eyes and short rounded ears, with light yellow and opaque yellow fur with black spots, the tail is hairy and relatively short, reaching 50% of the total length of this feline (Paviolo et al. 2015; Vallejo 2017).

In Ecuador, it has been recorded on both sides of the Andes (Tirira 2017) on the zoogeographic zones: Northwest Tropical, Southwest Tropical, Eastern Subtropical and Eastern Tropical (Albuja et al. 2012), in an altitudinal range from sea level to 2000 m (Albuja 2011). Due to habitat loss, poaching and conflicts with people, the ocelot is categorized as near threatened locally (Espinosa et al. 2011; Vallejo 2017) and, according to the International Union for Conservation of Nature (IUCN), this species is under the category of least concern (Paviolo et al. 2015). This neotropical feline has nocturnal habits, with some activity during the day (Dias et al. 2018). As an opportunistic predator, its diet consists of mainly small nocturnal terrestrial mammals, especially rodents (Moreno et al. 2006), but it may also contain birds, amphibians, reptiles, fish and insects (De Villa Meza et al. 2002). It has been reported that they occasionally catch medium to large mammals (De Villa Meza et al. 2002; Aliaga-Rossel et al. 2006; Sunquist and Sunquist 2009; Bianchi et al. 2010).

Although the ocelot occupies a wide variety of environments, it usually prefers sites in the forest with dense vegetation cover (Reid 2009). However, it explores open sites such as mineral licks (Blake et al. 2011), where rainwater accumulates and the soil is rich in minerals, such as calcium, magnesium, manganese, phosphorus, potassium and sodium, which are ingested (geophagy) by birds, reptiles, large and small mammals –including some species of bats and insects that are frequent at these sites and are regular ocelot prey (Moore et al. 2005; Voigt et al. 2008; Albuja and Arguero 2011; Link et al. 2011).

This study provides information on the activity patterns, stalking and predation behaviour of ocelot in mineral licks. We provide novel information that contributes

to the knowledge of the trophic ecology of this feline, which is fundamental for understanding the interactions and strategies of wildlife species in the ecosystem (Jaksic and Marone 2007).

Methods

Yasuni National Park is considered one of the most biodiverse areas in the world for their biological and cultural richness (Bass et al. 2010). From January 2018 until December 2019, the camera trap study was carried out in 10 mineral licks in the northern sector of this protected area as shown in Fig. 1. The study area is located within the Eastern Tropical zoogeographic floor (Albuja et al. 2012), composed mainly of non-flooded forests of mainland, temporarily flooded or Varzea forests and swampy sectors, where the moriche palm *Mauritia flexuosa* is dominant.

In each mineral lick, a photo-trapping station was established consisting of one camera trap (Bushnell Trophy Cam HD Aggressor). This camera was installed on the trunk of a tree, approximately 0.75 m above the ground, orientated towards where there were traces or evidence of wildlife activity. The camera traps remained active for at least 30 days, 24 hours a day and were programmed to capture three photographs. Additionally, a 15-second video was taken at 60-second intervals, each time the temperature and motion sensors detected an animal. For each station, the geographical location was recorded with a GPS (Garmin Oregon 650t model). The images obtained were entered and processed in the Wild.ID software (https://www.wildlifeinsights.org/team-network) and, based on the criteria of Tobler et al. (2009), Blake et al. (2011) and Link et al. (2012). Therefore, multiple photographs of the same individual during 60 minutes were considered to be a single record.

Using the R version 3.3.3 software and the overlap package (Ridout and Linkie 2009), independent records were obtained to establish the activity pattern of the ocelot within the mineral licks. Based on the hours of sunrise and sunset determined by the Software Sun Times v.7.1 (Kay and Du Croz 2008), the day was divided into four times: daytime (07:00–17:00 h), night (19:00–05:00 h), morning twilight (05:00–07:00 h), evening twilight (17:00–19:00 h) and the activity pattern was graphed according to the frequency of capture.

Results

With a sampling effort of 567 days/trap, 22 independent records were obtained from a total of 74 photographs and 21 videos where the ocelot appears in 5 of the 10 mineral lick studies. The peaks of activity of the ocelot turned out to be between 22:00–23:00 h and 03:00–04:00 h and it remained active mainly during the night and early morning (86.6% of records), with mild activity during the morning hours (13.6% of records). In addition, as the morning twilight approaches, its activity decreases, while during the evening twilight, the activity increases (Fig. 2).

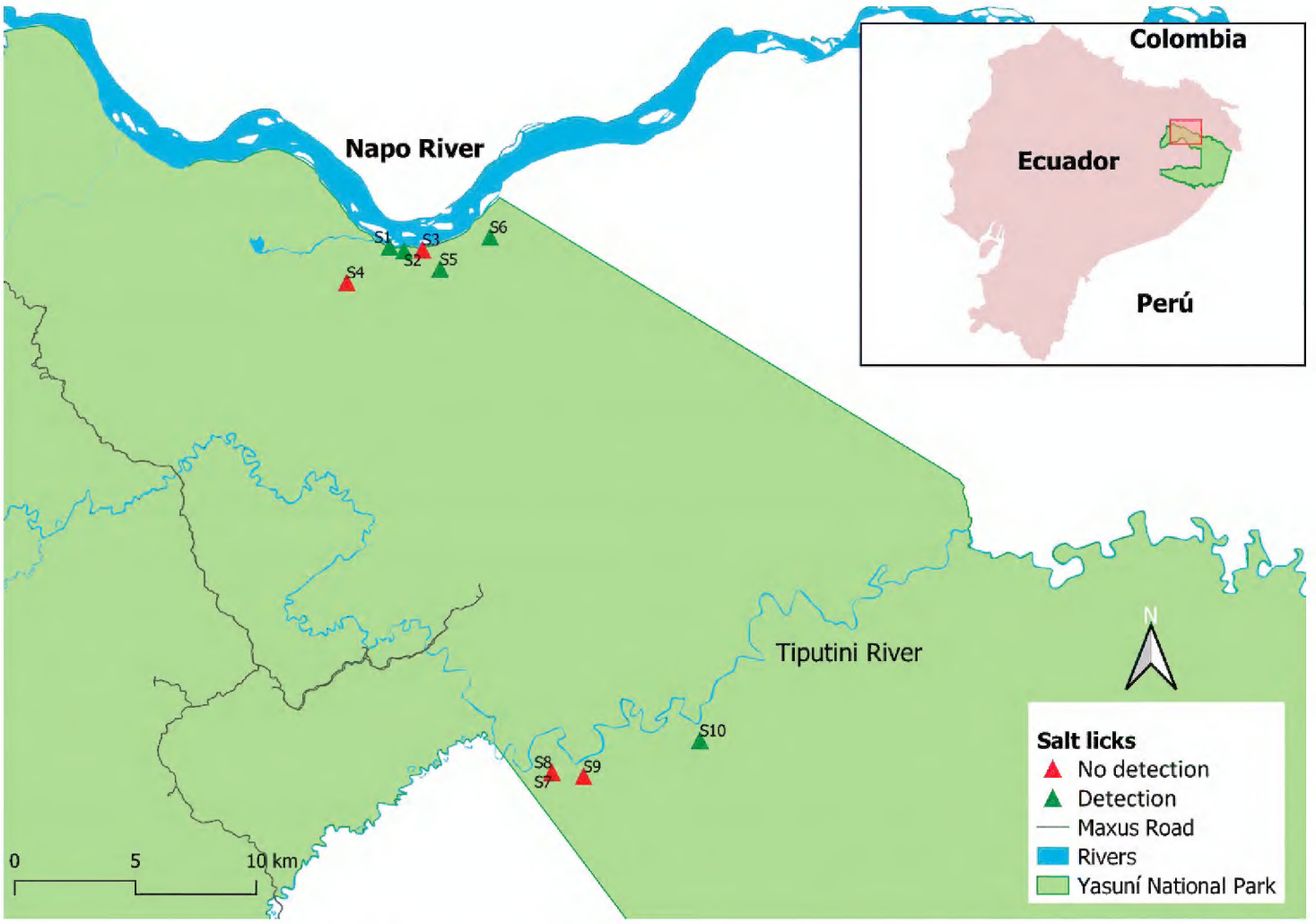

Figure 1. Location of the salt flats sampled in the northern region of the Yasuni National Park.

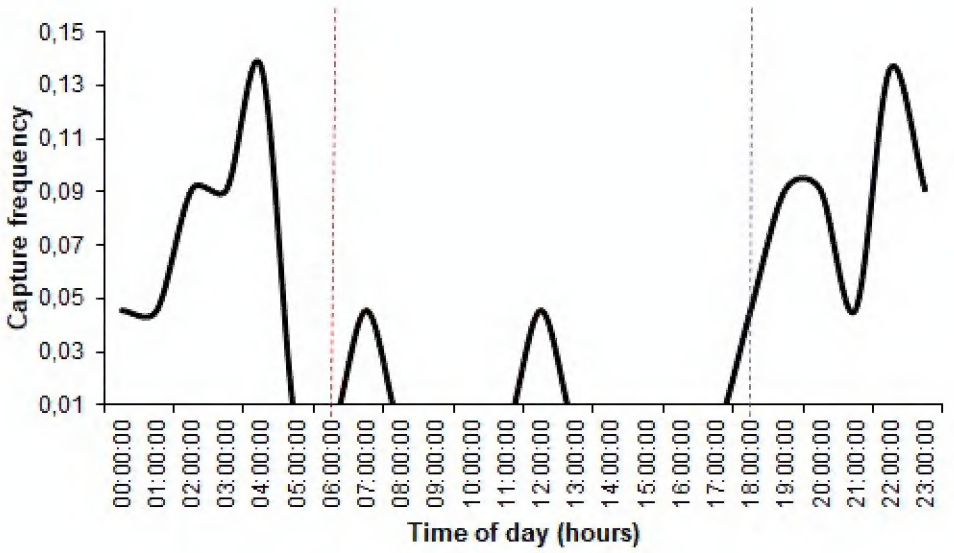

Figure 2. Frequency of activity of the ocelot obtained through camera trap records.

In photo-trapping stations S1, S2, S5, S6, S10 (Table 1), *L. pardalis* were detected; however, only images and videos of S5 were useful to describe ocelot's stalking and predation behaviour.

On 25 June 2018, at 04:38 h, an image was captured where the ocelot can be seen, in the foreground, in a stalking position and, a few metres ahead in the mineral licks, a red deer (*Mazama americana*) can be seen in the background of the

Table 1. Data from the photo-trapping stations where the ocelot was detected.

Lick	Trap-days	Number of photos and videos	Ocelot detection	Bats detection	Type lick
S1	48	833	3	Yes	Open
S2	78	2155	2	No	Open
S5	77	5592	11	Yes	Open
S6	78	6553	4	Yes	Open with a cave
S10	55	3634	2	Yes	Open

Figure 3. Image of the ocelot stalking a red deer in the mineral lick.

image. With some careful review of the sequence of the photographs and videos, no attack was recorded (Fig. 3).

On 7 November 2019, at 19:48 h, a video was recorded where the ocelot stealthily walks in a stalking position, to where an anuran (frog or toad) is located, but it manages to escape upon noticing the presence of the feline. The ocelot hastened its walk to try to catch it. However, the capture was unsuccessful (Fig. 4).

On 13 November 2019, at 20:37 h, an ocelot was recorded for a period of 15 seconds capturing a bat in the mid-flight; it should be noted that the video also shows the possible presence of an amphibian or reptile close to the ocelot. The recorded conditions of the capture were influenced at night with a waning gibbous moon, that is, between the full moon and the last quarter, where the luminosity

Figure 4. Image of "video 1" (Suppl. material 1) of the ocelot stalking and failing to capture an amphibian that frequents the mineral licks.

Figure 5. Image of "video 2" (Suppl. material 2) where the ocelot is seen eating a bat after capturing it in flight.

begins to decrease. The feline leaning on a rock is driven towards the group of bats in flight mode, managing to catch one with his snout, then it looked for a firm space to eat it. After the capture of an individual the bat, the group dispersed immediately (Fig. 5).

Discussion

Although the present study was carried out in ten mineral licks in the northern sector of the Yasuni National Park, the ocelot activity patterns were also obtained by Blake et al. (2012a), Salvador and Espinosa (2016), Blake et al. (2016) and Mosquera et al. (2016) in studies carried out in the same area. They agree that this species mainly has nocturnal habits, with higher activity peaks after sunset and before sunrise. Similar patterns of activity have been reported by other studies in the Neotropics (Ayala et al. 2010; Diaz-Pulido and Payán 2011; Pratas-Santiago et al. 2016) in open areas or on trails within the forest, even semi-arid environments (Penido et al. 2017).

The stalking and predation records reported here are associated with the ocelot's diet, mainly based on small nocturnal terrestrial mammals, especially rodents (Moreno et al. 2006), as well as amphibians; however, there are reports that the ocelot can capture larger prey, such as subadult white-tailed deer (*Odocoileus virginianus*) (De Villa Meza et al. 2002) and animals of the genus *Mazama* (Bianchi et al. 2010). Hence, it is likely that the ocelot will occupy these mineral licks to stalk the red and brown deer (*Mazama americana* and *Mazama nemorivaga*) that commonly visit these sites (Blake et al. 2011; Blake et al. 2012b).

The video report of the ocelot capturing a bat obtained in this study allows us to affirm the predation behaviour of the ocelot towards bats. These data were also evidenced by Tinoco and Camacho (2015) who managed to identify three individuals of *Saccopteryx bilineata* and one of *Micronycteris megalotis* in the stomach content of an ocelot. This was also reported by Contreras-Moreno et. al (2019) through photographic evidence of an ocelot with a bat on its snout.

Bats have not been considered an important food item compared to other prey, based on what was found in the stomach content study (Moreno et al. 2006). However, we can say that, in the Yasuni National Park, there are ocelots which occupy these sites to hunt and capture bats and other animals that use these mineral licks. In the specific case of the video recording we obtained, the ocelot jumped over the group of bats and managed to capture one, instead of opting for the amphibian or reptile that was in close proximity; preference may be due to a higher capture rate and because it can provide greater nutritious content to its diet.

In several images and videos used in this study, the ocelot could be seen resting or walking while sniffing, waiting for the best opportunity to hunt. The use of camera traps has made it possible to highlight the importance of mineral licks for this and other species of wildlife (Blake et al. 2011). It is likely that the mineral licks are where they go to ingest soil with a high concentration of minerals to compensate for the lack of necessary nutrition in the foods of their normal diet. It also helps them regulate and eliminate excess toxins from some foods and re-integrate them into the body's mineral reserves (Gilardi et al. 1999; García 2009), as well as compensating for the exhaustion by gestation and lactation processes (Wiley and Katz 1998). For the ocelot, mineral licks can be important for stalking and hunting prey that perhaps in the forest are difficult to obtain. These sites may be providing opportunities

for stalking and hunting with relatively low energy loss. Altogether, mineral licks become of great interest to study the interactions between predator and prey and other biotic interactions.

Acknowledgements

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Supplementary material 1

Ocelot stalking and failed capture of an amphibian
Authors: Patricio Macas-Pogo, Edison Mejía Valenzuela, Gabriela Arévalo-Serrano
Data type: Multimedia
Copyright notice: This dataset is made available under the Open Database License (http://opendatacommons.org/licenses/odbl/1.0/). The Open Database License (ODbL) is a license agreement intended to allow users to freely share, modify, and use this Dataset while maintaining this same freedom for others, provided that the original source and author(s) are credited.
Link: https://doi.org/10.3897/neotropical.18.e95027.suppl1

Supplementary material 2

Ocelot eating a bat after capturing it in flight
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Data type: Multimedia
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